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DRAFT
BIOVENTING TEST WORK PLAN FOR INSTALLATION RESTORATION PROGRAM SITE ST-27 CHARLESTON AFB, SOUTH CAROLINA

Prepared for:

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
BROOKS AFB, TEXAS

and

HEADQUARTERS 437 AIRLIFT WING (AMC)
CHARLESTON AFB, SOUTH CAROLINA

March, 1993

Prepared by:

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AQM01-03-0520

ENGINEERING-SCIENCE, INC.

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March 31, 1993

Mr. James Williams
Technical Program Manager
AFCEE/ESC Building 624 W
Brooks AFB, TX 78235-5000

Subject: Draft Bioventing Work Plan
IRP Site ST-27
Charleston AFB, South Carolina

Dear Mr. Williams:

Enclosed are two copies of the Draft Bioventing Work Plan for IRP Site ST-27, Charleston Air Force Base, South Carolina. This Draft report serves as a site-specific addendum to the "Test Plan and Technical Protocol for a Field Treatability Test for Bioventing."

After review by AFCEE and Charleston AFB personnel, comments will be addressed and incorporated into a Final Work Plan. ES would like to begin initial testing at this site during the week of April 26, 1993. As noted in the Draft Work Plan, the bioventing pilot study will be scheduled in consideration of other activities planned for this site.

If you have any questions concerning this work plan or the proposed testing schedule, please call me at (919) 677-0080 or Mr. Doug Downey at (303) 831-8100.

Sincerely,

ENGINEERING-SCIENCE, INC.

S. Grant Watkins

S. Grant Watkins, P.G.
Site Manager

Enclosure

cc: Ms. Susan Davis (Charleston AFB)

CONTENTS

FIGURES

BIOVENTING TEST WORK PLAN FOR INSTALLATION RESTORATION PROGRAM SITE ST-27 CHARLESTON AFB, SOUTH CAROLINA

1.0 INTRODUCTION

This site-specific work plan presents the scope of a bioventing pilot test for *in situ* treatment of fuel-contaminated soils at Installation Restoration Program (IRP) Site ST-27, Charleston Air Force Base, South Carolina. The proposed pilot test has three primary objectives: 1) to assess the potential for supplying oxygen throughout the contaminated soil depth in the study area, 2) to determine the rate at which indigenous microorganisms will degrade the fuel when stimulated by oxygen-rich soil gas, and 3) to evaluate the potential for sustaining these rates of biodegradation until fuel contamination is remediated below regulatory standards.

As discussed in this work plan, the pilot test will be conducted in two separate phases in consideration of current site conditions and work scheduled by other contractors at this site. If bioventing proves to be a feasible technology for this site, pilot test data will be used to design a full-scale remediation system and to estimate the time required for remediating soils to regulatory standards. Several added benefits are expected during the pilot testing phase at Site ST-27. First, a significant amount of the fuel contamination in the test area should be biodegraded during the one year pilot test. Additionally, test conditions at this site will allow the Air Force to evaluate the effectiveness of bioventing in shallow water table conditions in conjunction with aquifer dewatering and product extraction.

Initial testing will involve one vertical air injection (vent) well and small, portable vacuum blowers capable of sustaining flow rates of between 1 to 5 standard cubic foot per minute (scfm). The portable blowers will be used only for the initial air permeability test and respiration tests to be conducted during a one-week period. Data from these tests will be used to determine site parameters such as soil air permeability and oxygen utilization rates within a small-scale test area. A phased testing approach and downscaled test area are proposed since the test zone borders an immiscible product plume and air injection must be carefully executed to prevent uncontrolled displacement of vapors into nearby structures.

An extended, one-year bioventing pilot study will be implemented if the initial *in situ* respiration test demonstrates that significant fuel biodegradation can occur at Site ST-27. Design and implementation of the extended test will be based on the initial test parameters and will be coordinated with aquifer dewatering and product extraction activities performed by an IRP contractor. Blower sizing and the final vent well design and placement for extended testing will be based on the initial test results and the overall test objectives. It is feasible that the initial test vent well will be utilized for extended bioventing testing.

Additional background information on the development and recent success of the bioventing technology is found in the document entitled *Test Plan and Technical*

Protocol For A Field Treatability Test For Bioventing (Hinchee et al., 1992). This protocol document is a supplement to the site-specific work plan and it will also serve as the primary reference for pilot test well designs and detailed test objectives and procedures. Unless otherwise noted, test procedures outlined in the protocol document will be used during the pilot test at Site ST-27.

2.0 SITE DESCRIPTION

2.1 Installation Restoration Program Site ST-27

2.1.1 Site Location and History

IRP site ST-27 is located on the western edge of the MAC Maintenance Apron adjacent to Maintenance Building 575. The site was previously known as Site 20-Building 575 Fuel Tank Site before it was designated as an IRP site. (Versar, 1992). The site is covered by approximately 12 inches of concrete and/or asphalt extending at least one hundred feet in all directions from Building 575. Figure 2.1 shows the location of Site ST-27 with respect to the base.

Site ST-27 is operated as an aircraft maintenance hanger and fuel storage facility. From the 1950's until 1988, two steel underground storage tanks (USTs) were operated at the site. These USTs consisted of a 3,000-gallon JP-4 jet fuel tank and a 1,000-gallon MOGAS (leaded and unleaded gasoline) tank. A third steel UST, a 10,000-gallon JP-4 fuel tank, was installed at the site in 1977. The 10,000-gallon JP-4 fuel tank was constructed within a subsurface concrete containment structure. Leaks were detected in both the 1,000-gallon MOGAS tank and the 3,000-gallon JP-4 tank and these tanks were subsequently removed in 1988. Both USTs were replaced with 4,000-gallon fiberglass tanks (Versar, 1992).

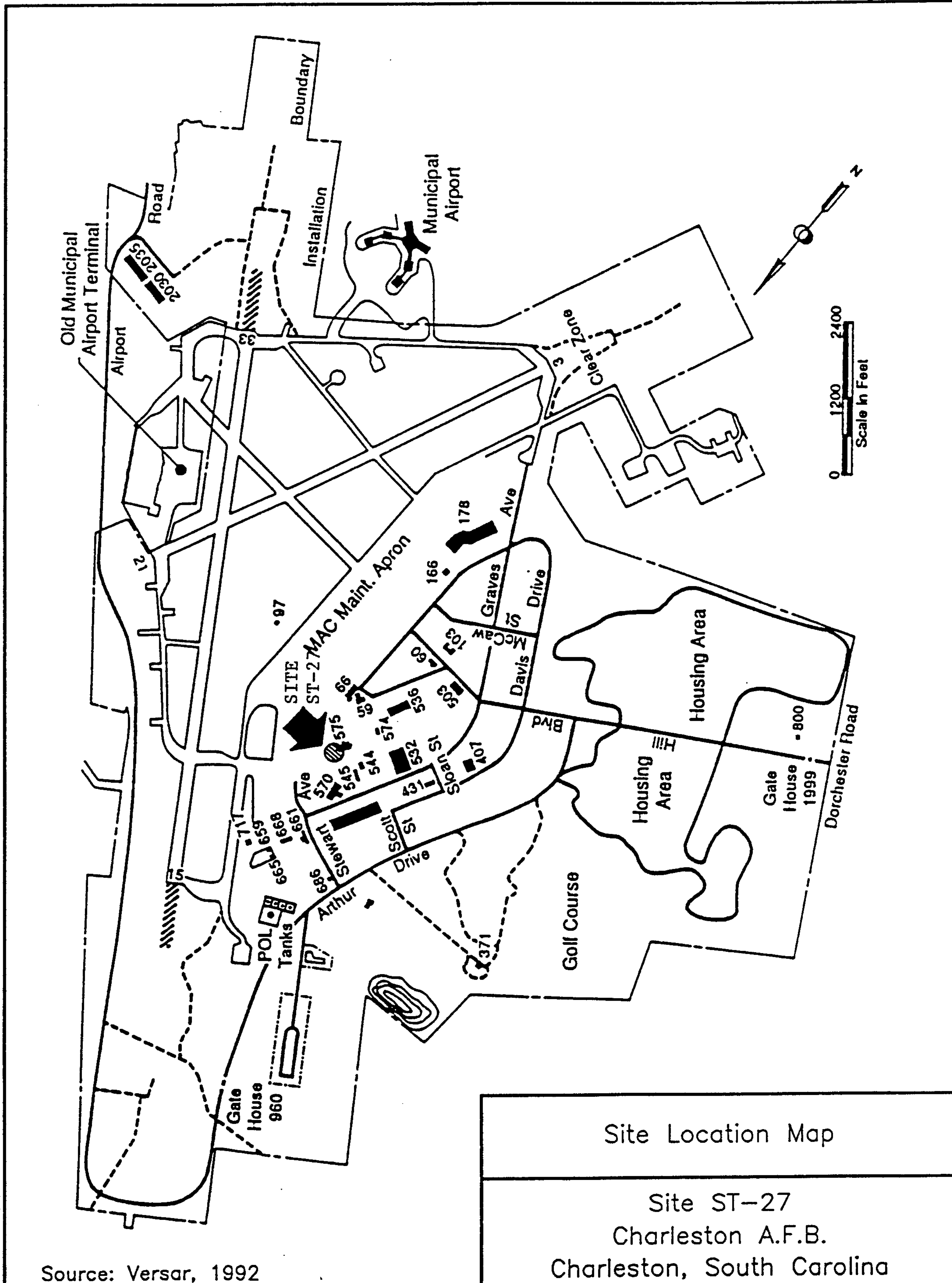
2.1.2 Previous Investigations

Eight groundwater monitoring wells were installed at Site ST-27 during two phases of remedial investigations executed by General Engineering Laboratories, Inc. (GEL) and by Versar, Inc.. As referenced in the Phase II Remedial Investigation/Feasibility Study Report, Stage 2 (Versar, 1992), the five original wells (20-1 through 20-5) were installed by GEL in 1988. These five shallow wells were screened across the water table at the time of installation. Three additional wells (20-6 through 20-8) were installed by Versar in 1990 during the IRP investigation. One of these wells (20-8) is constructed as a deep well screened in the lower zone of the surficial aquifer. Figure 2.2 shows a site map with the locations of all eight monitoring wells at Site ST-27.

Both soil and groundwater contamination by fuel products have been detected at the site. One monitoring well (20-1) has routinely contained floating, immiscible fuel with thicknesses ranging from a sheen to approximately 0.60 feet (Versar, 1992). Because leaks were detected in both the JP-4 tank and the MOGAS tank, it is possible that the product layer is a mixture of the two fuels. Field sampling notes from Versar (1992) describe the product layer as characteristic of JP-4 jet fuel.

According to the Site Contact at Charleston AFB, additional remedial investigations and remediation activities are scheduled by an IRP contractor for late spring and early

Figure 2.1



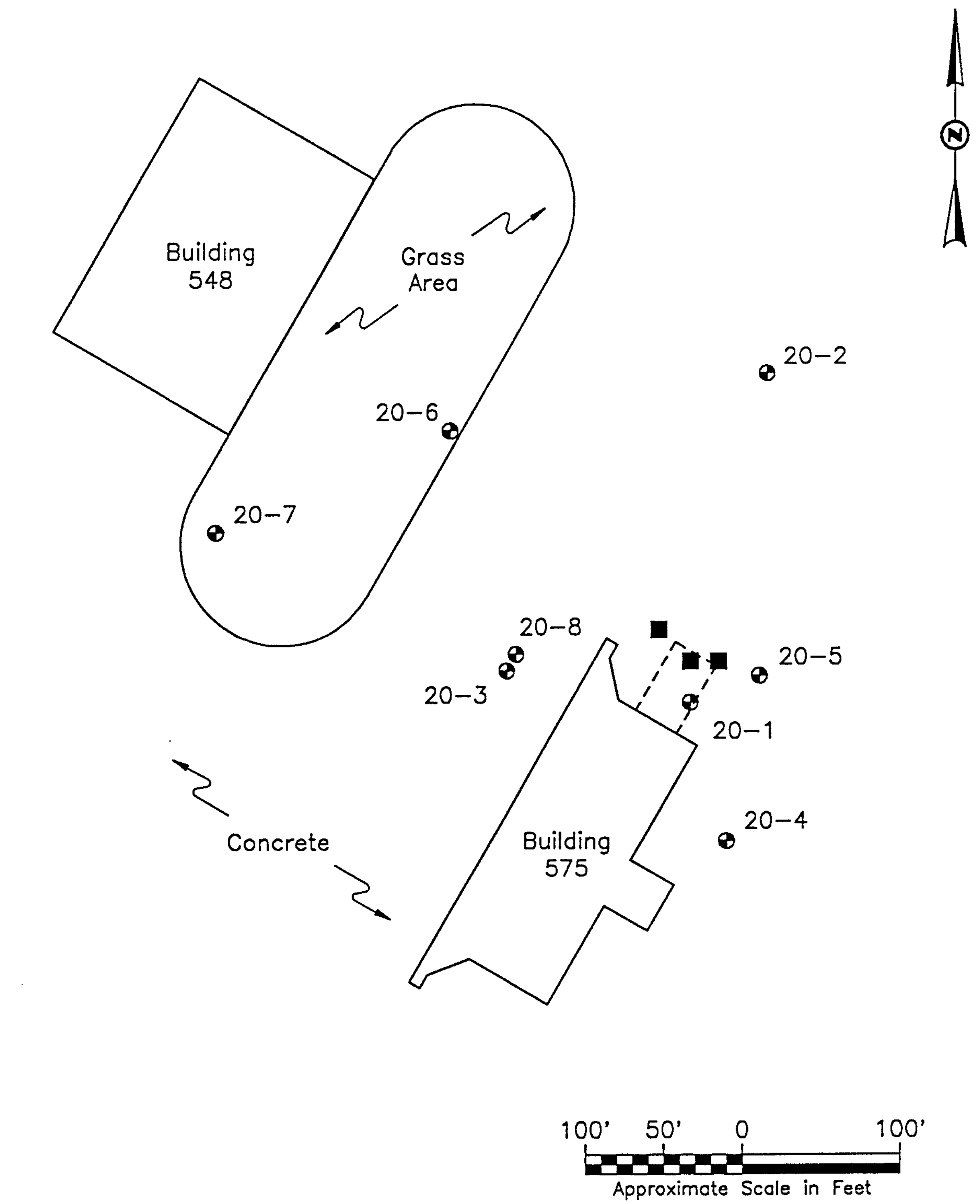
Source: Versar, 1992

Site Location Map

Site ST-27
Charleston A.F.B.
Charleston, South Carolina

RD268-08.dwg / 1=1 / 3-19-93 / TLP

Figure 2.2



LEGEND

- ⊕ Existing groundwater monitoring well.
- ■ Underground storage tank.

Site Plan with
Monitoring Well Locations

Site ST-27
Charleston A.F.B.
Charleston, South Carolina

DE268-14.dwg / 1=100 / 3-22-93 / TLP

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summer of 1993 at Site ST-27. Additional monitoring wells and two test/extraction wells are proposed for installation. These activities will precede construction of a full-scale groundwater extraction and treatment system tentatively scheduled for operation by the fall of 1993. Preliminary scheduling and design of the groundwater extraction system were discussed with ES in a January 11, 1993 meeting at the base. ES plans to coordinate the bioventing pilot tests accordingly. The bioventing and groundwater extraction technologies, when conducted simultaneously, are anticipated to compliment each other for overall contaminant reduction at the site.

2.1.3 Site Geology

Charleston AFB is located in the Lower Coastal Plain physiographic province of South Carolina. Sediments beneath the base are characterized as a thick sequence of interbedded sands, silts, and clays formed by fluvial and marine processes. These interbedded layers are grouped into regional formations and aquifers based on lithologic and water quality characteristics. Surficial soils around the base are generally sandy and highly permeable at shallow depths, but may contain zones of clay and organic deposits. The area is marked by low geomorphic relief.

The shallow stratigraphy at Charleston AFB consists of sands, silts, and clays of the Ladson Formation to average depths ranging from 30 to 50 feet below ground surface (bgs). The Ladson Formation forms the surficial unconfined aquifer in the vicinity of the base. Beneath the Ladson Formation are low-permeability clays and carbonate deposits of the Cooper Formation, which form a regional aquitard in this area. Boring logs from Site ST-27 indicate that the site is underlain by fine to medium sands, silty sands, and clayey sands within the upper 30 feet. A low-permeability clay layer, thought to represent the uppermost confining boundary of the Cooper Formation, was encountered at a depth of 34 feet bgs in well 20-8. Nonresidual fill material may also be present at various locations beneath the concrete pad.

Groundwater is encountered at average depths ranging from 4.0 to 8.5 feet bgs at Site ST-27. Seasonal water table fluctuations up to 3.1 feet over a one year period have been documented during routine monitoring (Versar, 1992). ES noted in February, 1993 that the water level in well 20-8 (deep well) was almost 4 feet higher than average water level elevations for that well. Anomalously high water table conditions have been observed at the base in recent months, attributed to frequent and heavy precipitation events during the fall and winter months of 1992. The water table was estimated as 4.5 feet bgs in the vicinity of well 20-3 in February, 1993. Water levels in 20-3 are typically between 7 to 8 feet bgs during the summer months.

The groundwater flow direction is highly variable at Site ST-27 and has historically shown patterns of both radial and converging flow. Flow directions towards the west, north, and east have been recorded, depending on seasonal conditions and local influences. Hydraulic gradients are relatively low, ranging from 0.027 to 0.006. Groundwater seepage velocity is estimated between 31 feet to 140 feet per year (Versar, 1992).

2.1.4 Site Contaminants

The primary contaminants at this site are petroleum hydrocarbons, which have been detected in unsaturated soils and groundwater at depths ranging from near ground surface to about 30 feet bgs. Quantitative soils analyses were limited to one sampling location (boring for 20-8) during the IRP investigation. Total recoverable petroleum hydrocarbon (TRPH) maximum concentrations of 135 milligrams per kilogram (mg/kg) were detected in shallow soils in the boring for well 20-8. Volatile organic compounds benzene, toluene, ethylbenzene, and total xylenes (BTEX) were detected in both soils and groundwater at the site. Total BTEX concentrations of 940 mg/kg were detected in soil samples collected from 20-8. In August 1990, well 20-3 contained 34,300 micrograms per liter (ug/l) of total BTEX and 190 ug/l of Naphthalene dissolved in groundwater. Lead (dissolved and total) has also been detected in groundwater at the site.

Although soil analytical data are limited for this site, significant soil contamination is expected in the unsaturated zone. The presence of immiscible fuel, elevated concentrations of dissolved petroleum compounds, and large fluctuations of the water table typically create a large contaminant "smear" zone within the vadose zone soils. An even larger zone of contaminated soils should be exposed for treatment when the water table declines from groundwater extraction and seasonal variations. This zone of residual soil contamination will be most pronounced within the vicinity of the immiscible product plume.

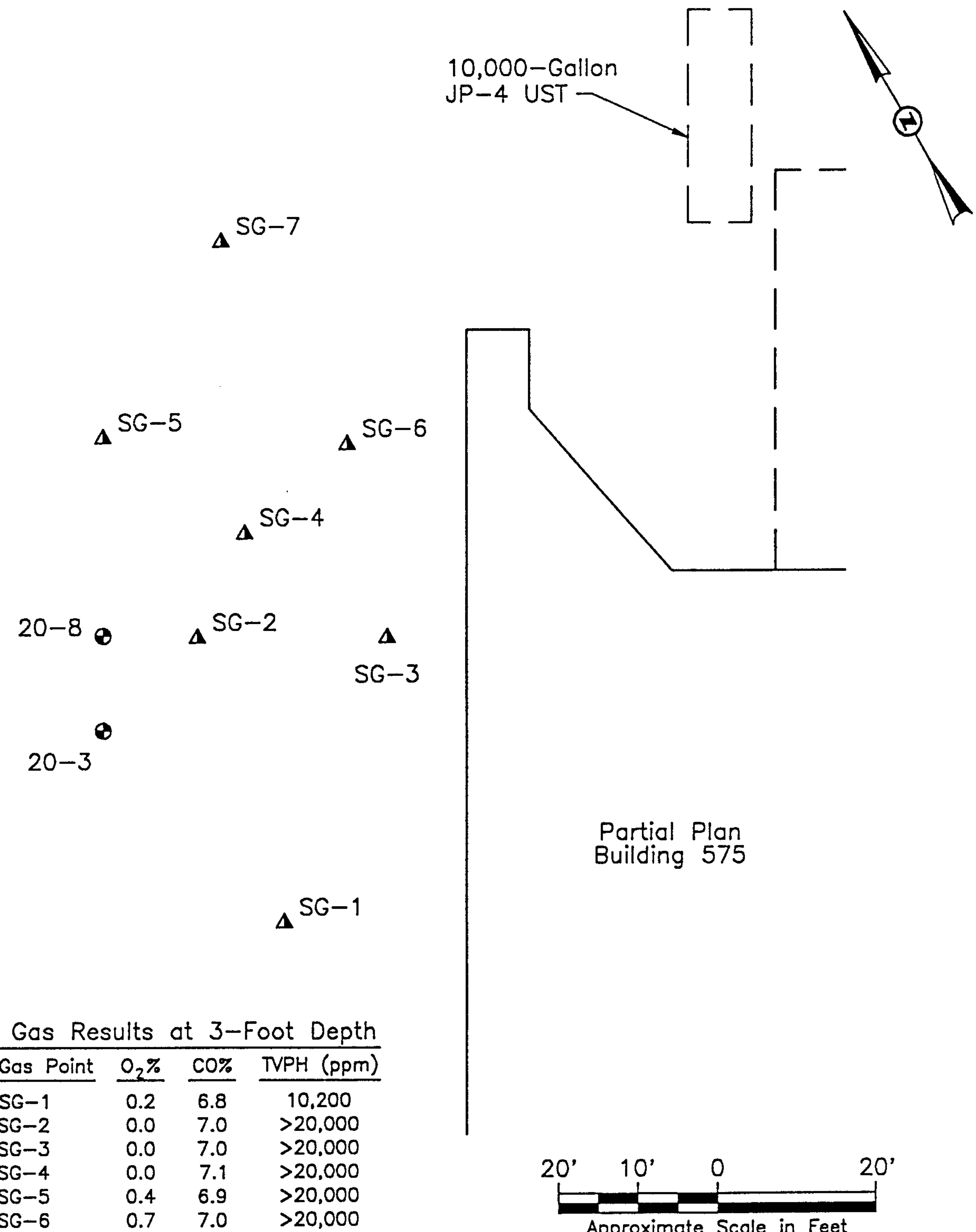
2.1.5 Results of Soil Gas Survey

ES conducted a preliminary soil gas survey at Site ST-27 on February 18, 1993 as part of a base-wide search for candidate bioventing study sites. Seven soil gas test points were advanced on the west side of Building 575, within 100 feet of the former leaking USTs. This portion of the site was chosen for the soil gas survey because it is located in an area of elevated groundwater contamination near the suspected boundary of the immiscible product plume. The survey test area was also placed in the vicinity of a proposed groundwater extraction well, where maximum lowering of the water table should occur. Current plans are for a groundwater extraction well to be placed within 25 feet of the proposed vent well location.

The soil gas probes were equipped with a nondedicated, retractable tip for collection of soil gas samples from multiple depths at each test point. Soil gas samples were collected from depths of 2 feet bgs and 3 feet bgs at each of the seven test locations. ES attempted to collect soil gas samples from depths of 4 feet bgs from two of test points, but water was drawn into the sampling tubes at this depth.

Results of the soil gas survey indicate that unsaturated soils beneath the concrete pad are oxygen deficient ($<5\%$ O_2) at the 2-foot depth and the soils are essentially oxygen depleted (0% O_2) at 3 feet. At each of the test points, total volatile petroleum hydrocarbon (TVPH) organic vapors exceeded the 20,000 part per million (ppm) detection limit of the instrument, which was equipped with a dilution fitting. These results suggest that anaerobic conditions are present in the subsurface and that a large quantity of vapor-phase contamination exists beneath the pad in the vicinity of the immiscible product plume. Figure 2.3 depicts the test point locations and soil gas readings obtained at the 3-foot depth.

Figure 2.3



Soil Gas Results at 3-Foot Depth

Soil Gas Point	O_2%	CO%	TVPH (ppm)
SG–1	0.2	6.8	10,200
SG–2	0.0	7.0	>20,000
SG–3	0.0	7.0	>20,000
SG–4	0.0	7.1	>20,000
SG–5	0.4	6.9	>20,000
SG–6	0.7	7.0	>20,000
SG–7	0.5	6.5	>20,000

LEGEND

20–8 ● Existing groundwater monitoring well.

SG–7 ▲ Soil gas monitoring point.

Soil Gas Survey Results

Site ST–27
Charleston A.F.B.
Charleston, South Carolina

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3.0 SITE SPECIFIC ACTIVITIES

The purpose of this section is to describe the proposed location of the central vent well (VW) and vapor monitoring points (MPs) at Site ST-27. Soil sampling procedures and the blower configuration for air (oxygen) injection into contaminated soils are also discussed in this section. A 2-inch air injection vent well will be completed into the water table in anticipation of future aquifer dewatering and seasonal lowering of the water table. Pilot test activities will target unsaturated soils bioremediation, particularly those contaminated zones exposed by aquifer dewatering. Well construction records indicate that existing monitoring wells at Site ST-27 do not meet the criteria for use as vapor/pressure monitoring points (MPs) during the pilot test. Four MPs, including one background vapor monitoring point, will be installed for this purpose.

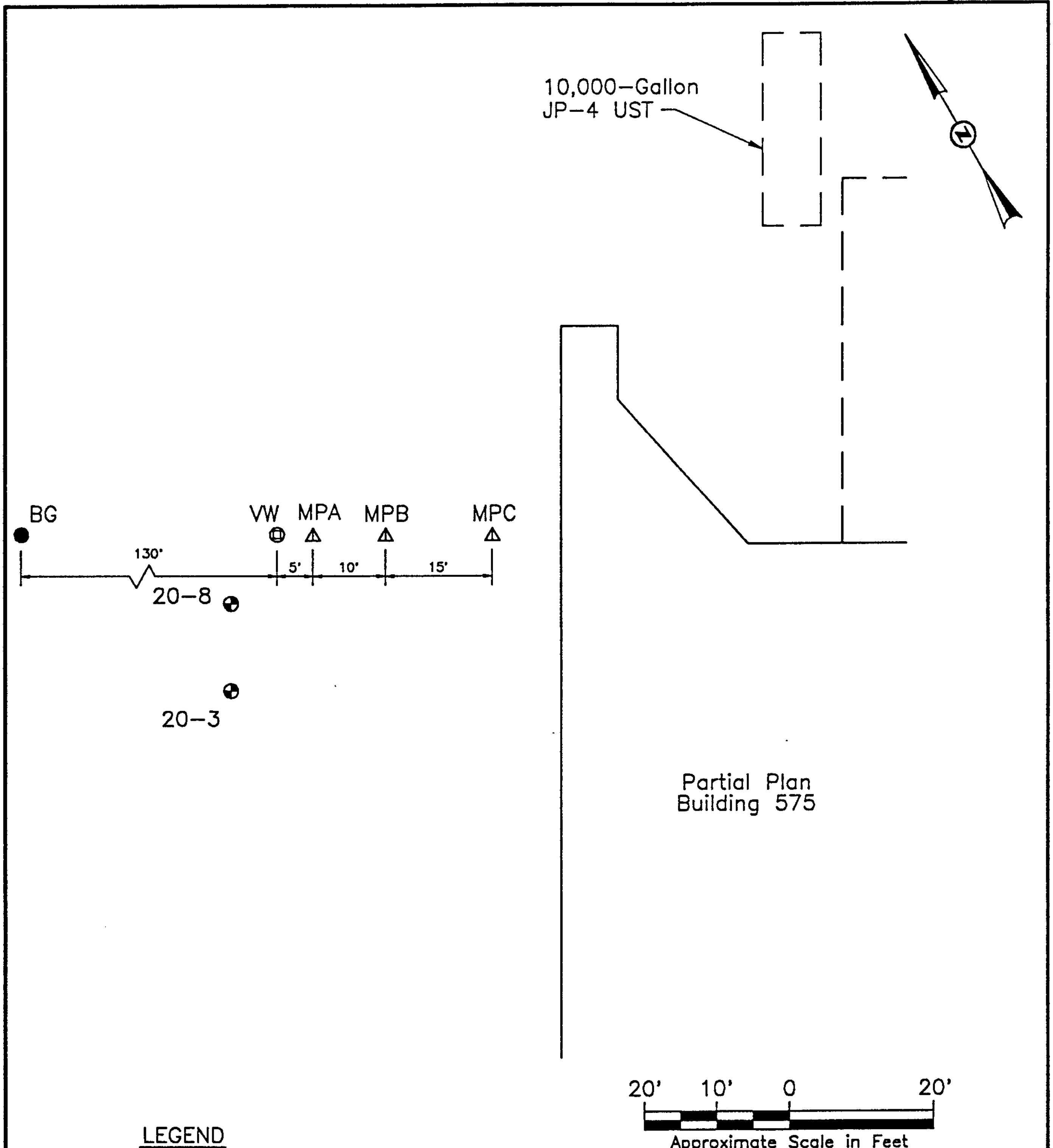
3.1 Bioventing Test Design For Site ST-27

A general description of criteria for siting a central VW and MPs are included in the attached protocol. Figure 3.1 illustrates the proposed locations of the air injection VW and MPs. These locations are based on the soil gas survey results, proximity to known contaminated soils, and dewatering activities proposed for this area. Soils in the test area are oxygen depleted and increased biological activity should be stimulated by oxygen-rich soil gas ventilation during full-scale operations. The final locations of these wells may vary slightly from the locations shown in Figure 3.1 based on site conditions at the time of installation.

Considering the shallow depth of contamination of unsaturated soils at this site (< 5 feet bgs), the soil lithology, and the venting well configuration required to accommodate shallow water table conditions, the effective radius of venting influence around the air injection vent well is expected not to exceed 30 feet. The concrete cap will prevent short circuiting of injected air with the ground surface, thereby enhancing the radius of influence when low volumes of air are injected. A primary concern at this site is possible displacement of petroleum vapors into nearby structures, including the groundwater extraction well and the buildings and subsurface conduits associated with the proposed groundwater extraction/treatment system. Vapor migration will be controlled during the initial air permeability and respiration tests by using low-flow vacuum pumps for air injection. Data from these preliminary tests will then be used not only to determine if aerobic biodegradation can be stimulated, but also to select an appropriate blower and VW design for extended testing. As shown in Figure 3.1, three of the MPs will be located between the VW and Building 575 to monitor potential vapor movement toward the building.

The central air injection VW will be constructed of 2-inch ID Schedule 40 PVC, with 5 feet of 0.02-inch slotted screen. Flush-threaded casing and screen will be used for vent well construction, with no organic solvents or glues. The vent well will be set in a 4-inch diameter hand-augered borehole to a total depth of approximately 8 feet below ground surface. A filter pack of coarse silica sand will be placed entirely around the screened interval. Considering the water table elevations observed in February, 1993 (about 4.5 feet bgs), this installation depth will place the bottom of the screen approximately 3.5 feet below the expected seasonal high water table, with about

Figure 3.1



LEGEND

20–8 — Existing groundwater monitoring well.

VW — Proposed air injection vent well.

MPA — Proposed soil vapor/pressure monitoring point.

BG — Proposed background monitoring point.

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Proposed Air Injection Well and Monitoring Point Locations

Site ST–27
Charleston A.F.B.
Charleston, South Carolina

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1.5 feet of screen exposed above the water table for air injection. Seasonal trends demonstrate that the water table elevation will likely decline between 3 feet to 4 feet during the summer and fall months, thereby exposing the entire screened interval of the VW for air injection. Figure 3.2 illustrates the proposed air injection well construction for this site. The header pipe (from blower) shown attached to the VW in Figure 3.2 will not be installed until the permanent blower is installed.

Three vapor monitoring points will be located within a 30-foot radius of the central VW. These three MPs will be oriented in a straight line between the vent well and Building 575, installed at distances of 5, 15, and 30 feet from the vent well. A fourth MP will be installed for use as a background monitoring point to measure background levels of oxygen and carbon dioxide and to determine if natural carbon sources (i.e. organic layers) or mineral reactions are contributing to oxygen uptake during the *in situ* respiration test. The background MP will be installed near existing monitoring well 20-7, in a grassy area approximately 150 feet west-northwest of Building 575. Figure 3.1 shows the locations of the MPs relative to the VW. Additional details on the *in situ* respiration test are found in Section 5.7 of the technical protocol document.

A typical vapor monitoring point construction detail for this site is shown in Figure 3.3. Soil gas oxygen and carbon dioxide concentrations will be monitored at one depth interval, between 3.0 to 3.5 feet bgs, in each MP. Multi-depth monitoring is not feasible for this site, especially during periods of high water table conditions that occur much of the year. Sufficient oxygen delivery is expected throughout the entire unsaturated soil profile, even during low water table conditions when up to 7 or 8 feet of unsaturated soils may be exposed for bioventing. Oxygen delivery throughout the soil column will be facilitated by both the concrete surface cap and the relative homogeneous and permeable nature of the soils. The background MP will be constructed similar to the other three MPs. Additional details on vapor monitoring point construction are found in Section 4 of the protocol document.

3.2 Handling of Soil Boring Cuttings

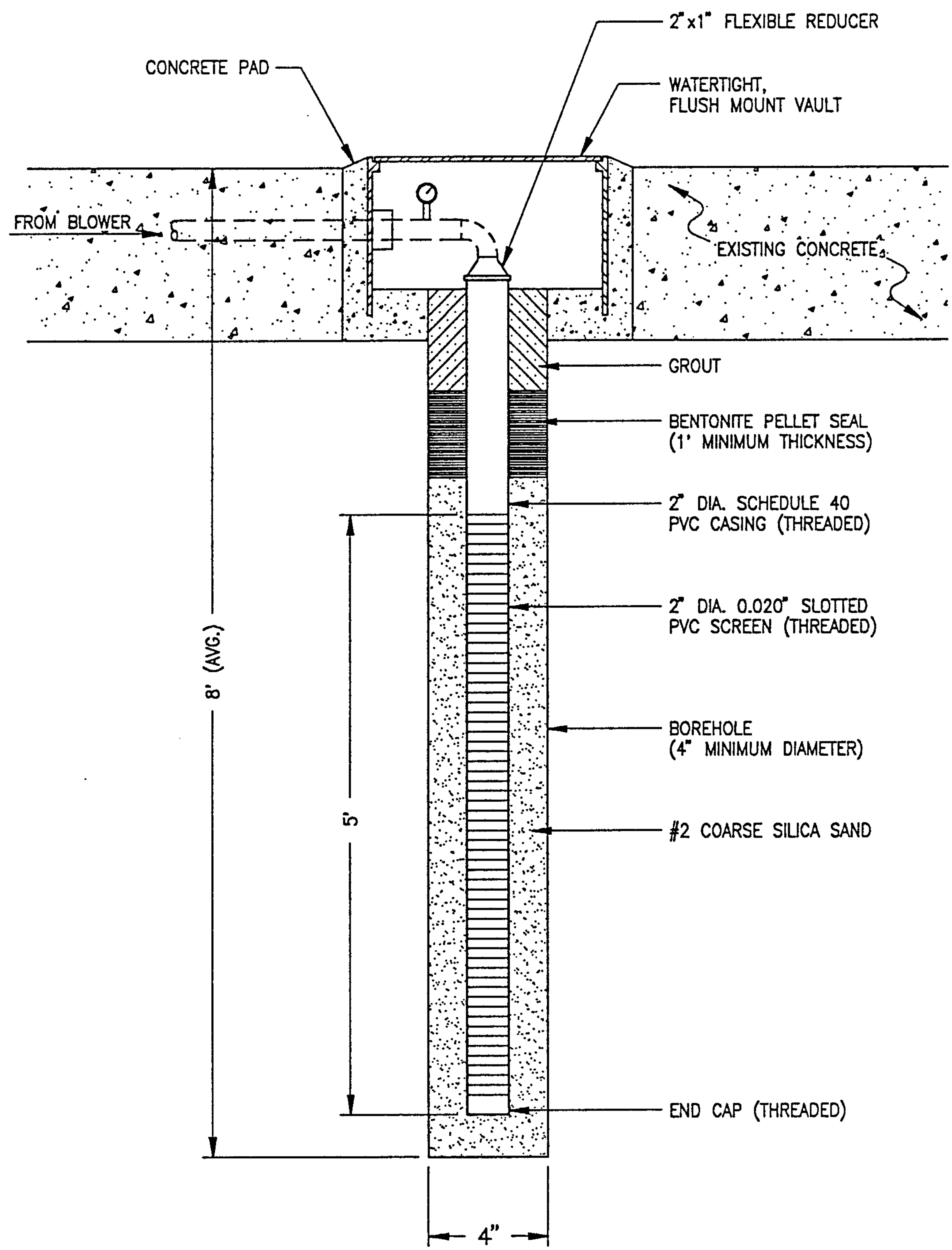
Cuttings from all soils borings and any remaining waste soils will be collected in a DOT-approved container. The containers will be labeled according to Base procedures and then placed in a designated Charleston AFB hazardous material storage area. These waste soils will become the responsibility of Charleston AFB and will be analyzed, handled, and disposed of in accordance with the current procedures for ongoing remedial investigations. This project is expected to generate less than one 55-gallon drum of soil cuttings.

3.3 Soil and Soil Gas Sampling

3.3.1 Soil Sampling

Three soil samples will be collected from the pilot test area during the installation of the VW and MPs. Sampling procedures will follow those outlined in the protocol document, with minor modifications for collection of a samples using a hand auger. One sample will be collected from the most contaminated interval of the central VW boring. One sample will be collected from the interval of highest apparent

Figure 3.2



NOTE: DRAWING IS NOT TO SCALE.

Proposed Injection Vent Well Construction

Site ST-27
Charleston A.F.B.
Charleston, South Carolina

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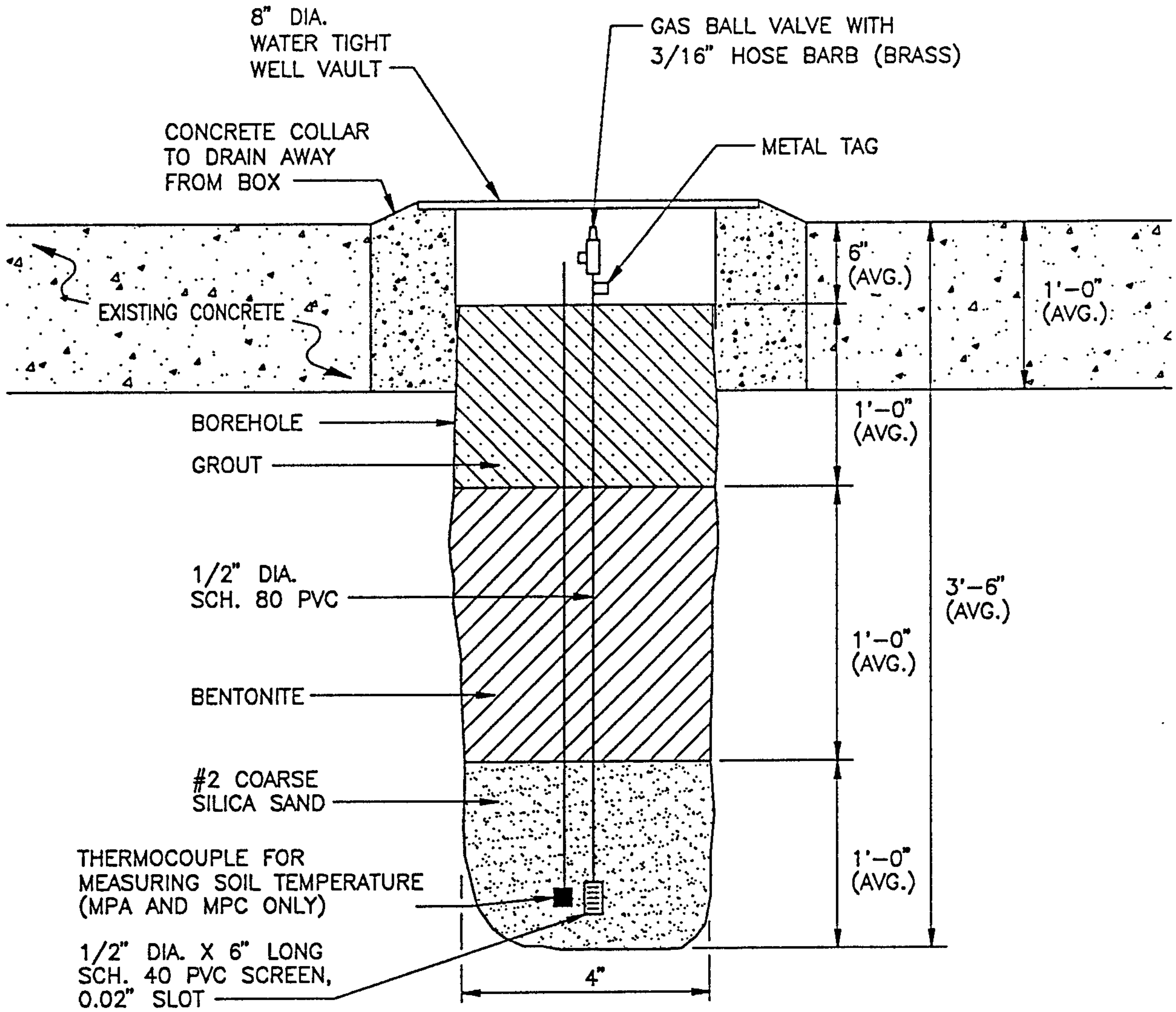
Figure 3.3



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Typical Monitoring Point
Construction Detail

Site ST-27
Charleston A.F.B.
Charleston, South Carolina

DE268-12.dwg / 1=1 / 3-19-93 / TLP

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contamination in each of the borings for the monitoring points, excluding the background monitoring point. Soil samples will be analyzed for TRPH, BTEX, soil moisture, pH, particle sizing, alkalinity, total iron and nutrients.

Samples will be collected by hand augering to the desired sampling depth and then immediately transferring the samples to laboratory-supplied sample jars using a stainless steel spoon. A photoionization detector or total hydrocarbon vapor analyzer (see protocol Section 4.5.2.) will be used to insure that breathing zone levels of volatiles do not exceed 1 ppmv while conducting soil borings and to screen samples for intervals of high fuel contamination. Soil samples will be labeled following the nomenclature specified in the protocol document (Section 5.5), wrapped in protective plastic, and placed in an ice chest for shipment. A chain of custody form will be filled out and the ice chest shipped to the Engineering-Science laboratory in Berkeley, California for analysis. This laboratory has been audited by the U.S. Air Force and meets all quality assurance/quality control and certification requirements for the State of California.

3.3.2 Soil Gas Sampling

A total hydrocarbon vapor analyzer (see protocol document, Section 4.5.2) will be used during the soil borings to screen sample intervals for fuel contamination. Once the monitoring points are installed and adequately purged, soil gas samples will be collected using SUMMA^R canisters. Three SUMMA^R canister soil gas samples will be collected, one from the VW and one each from the MPs closest to and furthest from the VW. Quantitative soil gas samples will be used to predict potential air emissions, to determine the reduction of BTEX and total volatile hydrocarbons (TVH) during the extended test, and to detect migration of these vapors from the source area.

Soil gas samples will be placed in a small ice chest and packed with foam pellets for protection during shipment. Samples will not be placed on ice to prevent condensation of hydrocarbon compounds. A chain-of-custody form will be completed and shipped with the samples to the Air Toxics, Inc. laboratory in Rancho Cordova, California. The soil gas samples will be analyzed for BTEX and TVH.

3.4 Blower System

A permanent blower for extended pilot testing will not be selected and installed at Site ST-27 until the initial air permeability and *in situ* respiration tests are completed and immiscible product recovery is underway. Small, portable vacuum blowers (1 to 5 scfm maximum) will be used to conduct the initial tests. Data from these tests will then be evaluated to size a blower for extended testing.

Test design criteria at Site ST-27 will most likely require a smaller blower for extended testing. A 0.3-HP to 0.5 HP regenerative blower capable of injecting 10 to 15 scfm at 1 psi may be adequate for extended test at this site. A small blower of this size should provide sufficient pressure to move low volumes of oxygen (minimum of 1 pore volume exchange per day) throughout the test area, without creating excessive vapor displacement. Air injection will be used to provide oxygen to soil bacteria and to minimize emissions of volatiles to the atmosphere. Figure 3.4 is a schematic of a typical air injection system that will be used for pilot testing at the site. Initial air

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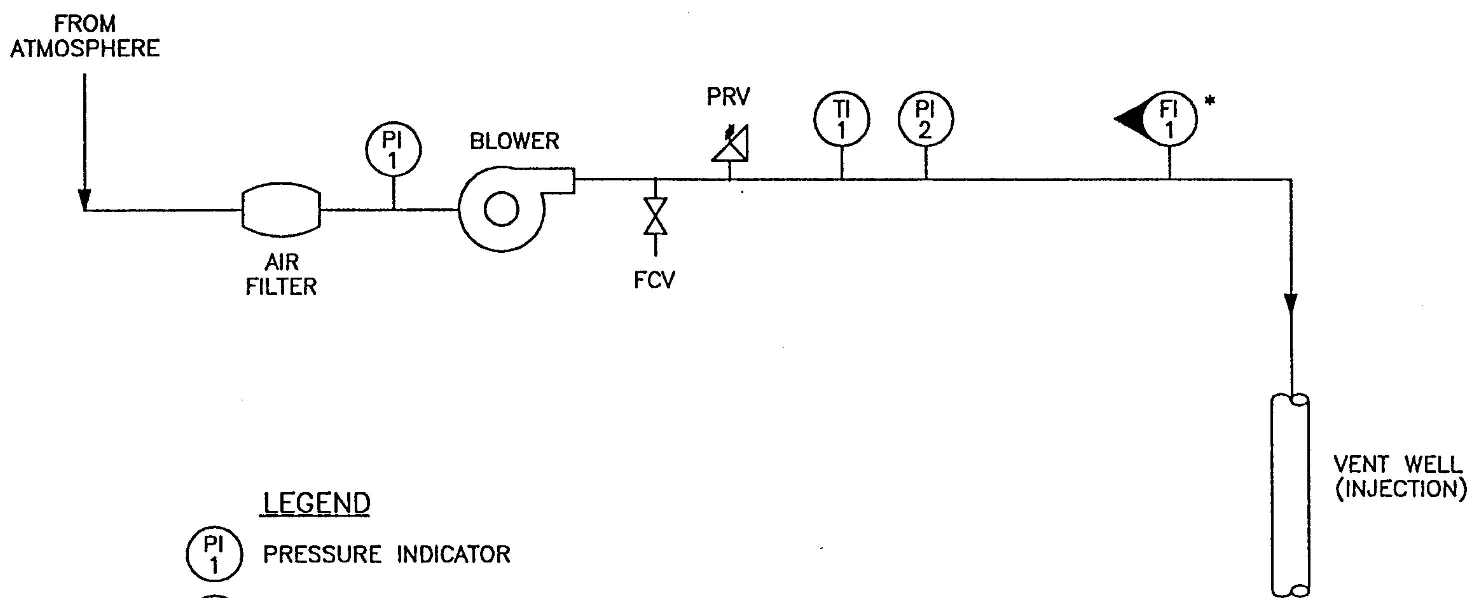

LEGEND

PI 1 PRESSURE INDICATOR

TI 1 TEMPERATURE INDICATOR

FI 1 FLOW INDICATOR (ROTAMETER)

FCV FLOW CONTROL VALVE (MANUAL AIR BLEED)

PRV PRESSURE RELIEF VALVE

* OPTIONAL

NOTE: Blower diagram shown is for permanent installation for extended testing. A low-flow vacuum pump equipped with a rotameter flow indicator is proposed for the initial air permeability and respiration tests.

DRAWING IS NOT TO SCALE

Blower System Instrumentation Diagram for Air Injection

Site ST-27
Charleston A.F.B.
Charleston, South Carolina

Figure 3.4

permeability testing results will be used to determine the optimum blower size for extended testing.

The maximum power requirement anticipated for the extended pilot test is a 115-Volt, Single-Phase (60 Hz), 30 Amp service. This service will not be required until the permanent blower is installed. Initial air permeability and respiration tests can be conducted using electrical extension cords and existing power in Building 575. Additional details on power supply requirements are described in Section 5.0, base Support Requirements.

As a safety precaution at Site ST-27, it is necessary that the extended test blower motor be explosion proof. The blower motor will be wired directly to the circuit breaker box, so a motor starter will not be required. Additionally, the cable running to the outlet near the breaker box will be explosion proof. The circuit breaker box shall be located 5 feet above the ground surface so that all non-explosion proof connections are above the hazardous area. base electricians will complete these explosion proof connections and the blower wiring.

4.0 EXCEPTIONS TO PROTOCOL PROCEDURES

The procedures that will be used to measure the air permeability of the soil and *in situ* respiration rates are described in Sections 4 and 5 of the attached protocol document. No deviations from the established testing protocol (Revised January, 1993) are anticipated. This includes the use of helium injection during the respiration tests to monitor potential short circuiting at the MPs. Several modifications for VW and MP construction, and soil sampling procedures are proposed.

Vent well construction will be modified slightly from the specifications in the technical protocol document. A 2-inch diameter well will be installed and the screened interval will extend into the water table at the time of construction. If this VW is used for extended testing, the exposed screen length will vary with water table fluctuations. Large variations in the exposed screen length may subsequently require periodic adjustments to the air injection pressures and flow rates to maintain consistent test conditions.

Soil borings for the VW and MP installations will be advanced using a hand auger at this site. Since a drill rig will not be used, the typical borehole diameter for each monitoring point will be approximately 4 inches, as illustrated in Figures 3.2 and 3.3. Additionally, soil samples will be collected with a hand auger rather than brass sampling sleeves or Shelby tubes. Vapor monitoring points will not be mutli-depth at this site as discussed in the technical protocol.

5.0 BASE SUPPORT REQUIREMENTS

5.1 Test Preparation

The following base support is needed prior to the arrival of a concrete coring contractor and the Engineering-Science test team:

- Name and phone number of base point of contact provided to the Engineering-Science project manager.

- Confirmation of regulatory approval and permitting for the pilot test, including the Underground Injection Control (UIC) permit and a permit for vent well installation as described in this work plan.
- Assistance in obtaining a digging permit at the ST-27 site.
- Uninterrupted access to a 110-volt electrical outlet at Building 575 for approximately 48 hours.
- Provide any paperwork required to obtain gate passes and security badges for approximately two Engineering Science employees and two concrete coring contractors. Vehicle passes will be needed for two trucks. Also, arrange for flight-line driver training of two ES employees for unescorted access to Site ST-27.

During the initial one week pilot test the following base support is needed:

- Twelve square feet of desk space and a telephone in a building located as near to the site as practical.
- A decontamination pad for cleaning hand augers.
- Accept responsibility for soil cuttings from vent well and monitoring point borings including any drum sampling to determine hazardous waste status.
- The use of a fax machine for transmitting 15 to 20 pages of test results.

For the one year extended pilot test at Site ST-27:

- A breaker box mounted on the northwest end of Building 575 which can supply 115-Volt, Single-Phase (60 Hz), 30 Amp service for the extended pilot test. The breaker box should be located five feet above the ground and include two circuit breakers and two 110-volt outlets to support testing equipment. The permanent blower will also be wired directly to the circuit breaker box by base personnel.
- Check the blower system at the site once a week to ensure that it is operating and to record the air injection pressure. Engineering-Science will provide a brief training session and an O&M checklist for this procedure.
- Notify Mr. Grant Watkins, Engineering-Science, Inc., Cary, North Carolina (919) 677-0080; Mr. Doug Downey, Engineering-Science, Inc. Denver, Colorado (303) 831-8100; or Mr. Jim Williams of the AFCEE, (800) 821-4528, ext 246 if the blower or motor stop operating.
- Arrange site access for an Engineering-Science technician to conduct *in situ* respiration tests approximately six months and one year after initiating the extended test.

5.2 Permit Requirements

Base personnel are responsible for obtaining all permits from the South Carolina Department of Health and Environmental Control (SCDHEC) that are required to perform the test as described in this work plan. If required, Engineering-Science will assistance this effort by providing test design criteria and reference documents for regulatory review. Unless directed by AFCEE or the base POC, no direct contact will be made between Engineering-Science and the regulatory agencies.

Based on previous bioventing tests at the base, the SCDHEC will require an Underground Injection Control (UIC) Permit to perform any air injection into the subsurface. This permit will regulate the vent well as a Class V injection well. The permit will be required for both the short-term air permeability/respiration test and the extended bioventing test. Therefore, the proposed test schedule is dependent on timely permit approval by SCDHEC. The Agency will also issue approval for the installation of the MPs and the VW. An air emissions permit will not be required for these tests.

6.0 PROJECT SCHEDULE

The following schedule is contingent upon timely approval of this pilot test work plan and on the schedules of other base contractors working at the site. Start-up of the extended, one-year test will be coordinated with remediation activities (i.e. groundwater extraction and treatment) performed by IRP contractors at the site. Long-term bioventing testing will not begin until the groundwater extraction system is operating. Location of the bioventing system and scheduling of its installation will be approved by the base to prevent interference with other activities planned for the site.

Event	Date
Draft Test Work Plan to AFCEE/Charleston AFB	March 31, 1993
Approval To Proceed	April 9, 1993
Begin Initial Pilot Tests	April 26, 1993
Complete Initial Pilot Tests	April 30, 1993
Interim Results Report	May 31, 1993
Six-month Respiration Test	To be determined
Final Respiration Test	To be determined

After a period of one year, a decision will be made by AFCEE and the base to either remove the system or to expand the system for full-scale remediation at the site.

7.0 POINTS OF CONTACT

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(803) 566-4978

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(303) 831-8100

8.0 REFERENCES

Hinchee, R.E., S.K. Ong., R.N. Miller, D.C. Downey, and R. Frendt., 1992. Test Plan and Technical Protocol for a Field Treatability Test for Bioventing. Prepared for Air Force Center for Environmental Excellence. May. Denver, Colorado.

Versar, Inc., Installation Restoration Program Phase II- Remedial Investigation/Feasibility Report Study, Stage 2, Charleston Air Force Base, Charleston, South Carolina, 1992 (Draft Report).

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